Malachi Phillips

Website: malachitimothyphillips.github.io
Email: malachi2@illinois.edu
LinkedIn: malachi-phillips-90879bb6
GitHub: github.com/MalachiTimothyPhillips

Education

University of Illinois — Champaign, IL
Ph.D. in Computer Science, GPA: 3.93/4.00 — 2018–2023 expected

- Thesis: "Spectral Element Poisson Preconditioners for Heterogeneous Architectures"

University of Oklahoma — Norman, OK
B.S. in Chemical Engineering, GPA: 4.00/4.00 — 2014–2018

- Thesis: "On biomass gasification of surgarcane bagasse and conversion into methanol products"

Experience

University of Illinois — Champaign, IL
Graduate Researcher, Dr. Paul Fischer — Fall 2018 –Present

- Develop nekRS, an integral contribution to the Center of Efficient Exascale Discretizations Project
- Prepare nekRS for Frontier
- Optimize GPU kernels through OCCA
- Speedup code performance by a factor of 3
- Implement several features: novel matrix-free pressure Poisson preconditioners, ALE, AVM, ...

Sandia National Laboratories — Albuquerque, NM
Software Developer — May 2016–Present

- Port large finite element method multiphysics simulation code to utilize GPUs through Kokkos
- Integrate new solver techniques, such as GCRODR, into code base
- Develop GPU kernel fusion through objected-oriented node fusion in expression graph

University of Oklahoma — Norman, OK
Undergraduate research assistant, computational fluid transport — August 2015 –May 2016

- Perform numerical simulations on transitional and fully-turbulent fluid flow
- Experience writing/debugging F77 code for DNS/Lagrangian scalar tracking

University of Oklahoma — Norman, OK
Undergraduate research assistant, computational chemistry — June 2014 –May 2016

- Design computational experiments to probe stability of amyloid fibrils
- Experience running simulations in popular programs such as GROMACS and AMBER

Publications

[1] Tzanio Kolev, Paul Fischer, Ahmad Abdelfattah, Adeleke Bankole, Natalie Beams, Michael Brazell, Jed Brown, Jean-Sylvain Camier, Noel Chalmers, Matthew Churchfield, Veselin Dobrev, Yohann Dudouit, Leila Ghaffari, John Holmen, Stefan Kerkemeier, Yu-Hsiang Lan, Yimin Lin, Damon McDougall, Elia Merzari, Misun Min, Ketan Mittal, Will Pazner, **Malachi Phillips**, Thilina Ratnayaka, Kris Rowe, Mark S. Shephard, Cameron W. Smith, Michael Sprague, Jeremy L. Thompson, Ananias Tomboulides,

Stanimire Tomov, Vladimir Tomov, Tim Warburton, and James Wright III. CEED ECP Milestone Report: Improve performance and capabilities of CEED-enabled ECP applications on Frontier/Aurora EA, September 2022.

[2] Tzanio Kolev, Paul Fischer, Ahmad Abdelfattah, Natalie Beams, Jed Brown, Jean-Sylvain Camier, Robert Carson, Noel Chalmers, Veselin Dobrev, Yohann Dudouit, Leila Ghaffari, Aditya Y. Joshi, Stefan Kerkemeier, Yu-Hsiang Lan, Damon McDougall, David Medina, Misun Min, Abhishek Mishra, Will Pazner, **Malachi Phillips**, Thilina Ratnayaka, Mark S. Shephard, Morteza H. Siboni, Cameron W. Smith, Jeremy L. Thompson, Ananias Tomboulides, Stanimire Tomov, Vladimir Tomov, and Tim Warburton. CEED ECP Milestone Report: High-order algorithmic developments and optimizations for more robust exascale applications, April 2022.

[3] Paul Fischer, Stefan Kerkemeier, Misun Min, Yu-Hsiang Lan, **Malachi Phillips**, Thilina Rathnayake, Elia Merzari, Ananias Tomboulides, Ali Karakus, Noel Chalmers, et al. Nekrs, a gpu-accelerated spectral element navier–stokes solver. *Parallel Computing*, 114:102982, 2022.

[4] Misun Min, Yu-Hsiang Lan, Paul Fischer, Elia Merzari, Stefan Kerkemeier, **Malachi Phillips**, Thilina Rathnayake, April Novak, Derek Gaston, Noel Chalmers, et al. Optimization of full-core reactor simulations on summit. In *2022 SC22: International Conference for High Performance Computing, Networking, Storage and Analysis (SC)*, pages 1067–1077. IEEE Computer Society, 2022.

[5] **Malachi Phillips** and Paul Fischer. Optimal chebyshev smoothers and one-sided v-cycles. *arXiv preprint arXiv:2210.03179*, 2022.

[6] **Malachi Phillips**, Stefan Kerkemeier, and Paul Fischer. Tuning spectral element preconditioners for parallel scalability on gpus. In *Proceedings of the 2022 SIAM Conference on Parallel Processing for Scientific Computing*, pages 37–48. SIAM, 2022.

[7] Tzanio Kolev, Paul Fischer, Natalie Beams, Jed Brown, Jean-Sylvain Camier, Noel Chalmers, Veselin Dobrev, Yohan Dudouit, Stefan Kerkemeier, Yu-Hsiang Lan, Yimin Lin, Neil Lindquist, Damon McDougall, David Medina, Elia Merzari, Misun Min, Scott Moe, Will Pazner, **Malachi Phillips**, Thilina Ratnayaka, Kris Rowe, Mark S. Shephard, Cameron W. Smith, Stanimire Tomov, and Tim Warburton. CEED ECP Milestone Report: Port and optimize the CEED software stack to Aurora / Frontier EA Systems, September 2021.

[8] Ahmad Abdelfattah, Valeria Barra, Natalie Beams, Ryan Bleile, Jed Brown, Jean-Sylvain Camier, Robert Carson, Noel Chalmers, Veselin Dobrev, Yohann Dudouit, Paul Fischer, Ali Karakus, Stefan Kerkemeier, Tzanio Kolev, Yu-Hsiang Lan, Elia Merzari, Misun Min, **Malachi Phillips**, Thilina Rathnayake, Robert Rieben, Thomas Stitt, Ananias Tomboulides, Stanimire Tomov, Vladimir Tomov, Arturo Vargas, Tim Warburton, and Kenneth Weiss. Gpu algorithms for efficient exascale discretizations. *Parallel Computing*, 108:102841, 2021.

[9] Elizabeth Koning, **Malachi Phillips**, and Tandy Warnow. ppiacerdc: a new scalable phylogenetic placement method. In *Proceedings of the 12th ACM Conference on Bioinformatics, Computational Biology, and Health Informatics*, pages 1–9, 2021.

[10] Tzanio Kolev, Paul Fischer, Ahmad Abdelfattah, Valeria Barra, Natalie Beams, Jed Brown, Jean-Sylvain Camier, Noel Chalmers, Veselin Dobrev, Stefan Kerkemeier, Yu-Hsiang Lan, Elia Merzari, Misun Min, **Malachi Phillips**, Thilina Ratnayaka, Kris Rowe, Jeremy Thompson, Ananias Tomboulides, Stanimire Tomov, Vladimir Tomov, and Tim Warburton. CEED ECP Milestone Report: Support CEED-enabled ECP applications in their preparation for Aurora/Frontier, September 2020.

[11] Erik J Alred, **Malachi Phillips**, Manikanthan Bhavaraju, and Ulrich HE Hansmann. Stability differences in the nmr ensembles of amyloid β fibrils. *Journal of Theoretical and Computational Chemistry*, 15(07):1650059, 2016.

[12] Manikanthan Bhavaraju, **Malachi Phillips**, Deborah Bowman, Juan M Aceves-Hernandez, and Ulrich HE Hansmann. Binding of ace-inhibitors to in vitro and patient-derived amyloid-β fibril models. *The Journal of Chemical Physics*, 144(1):015101, 2016.

[13] Erik J Alred, **Malachi Phillips**, Workalemahu M Berhanu, and Ulrich HE Hansmann. On the lack of polymorphism in aβ-peptide aggregates derived from patient brains. *Protein Science*, 24(6):923–935, 2015.

Teaching

- **Graduate Teaching Assistant** at University of Illinois — Spring 2020
  Numerical Methods for PDEs (CS555)
- **Graduate Teaching Assistant** at University of Illinois — Fall 2019
  Numerical Analysis (CS450)
- **Graduate Teaching Assistant** at University of Illinois — Spring 2019
  Numerical Analysis (CS450)
  - Nominated for Teaching Assistant Award

Skills

- **Languages:** C++, Python, FORTRAN90
- **Programming Models:** MPI, OpenMP, OCCA, Kokkos, CUDA, HIP
- **Tools:** LaTeX, Git

Projects

- **nekRS**
  Open source Navier Stokes solver based on the spectral element method targeting modern processors and accelerators.
- **nek5000**
  Nek5000 is a fast and scalable open source CFD solver.
- **occa**
  Open source library for programming on heterogeneous architectures.
- **pplacerDC**
  Scalable phylogenetic placement tool.
- **Sierra Mechanics**
  Sandia's engineering mechanics simulation code suite.

Scholarships and Awards

- Kuck Computational Science and Engineering Scholarship for the 2020-21 academic year.
- Chickasaw Nation Higher Education Scholarship.
- SURGE Fellowship.

Volunteering & Mentoring

- UIUC SIAM student chapter president 2020–Current
  Plan social events, seminars for SIAM student chapter at UIUC.